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14. ABSTRACT
This Test Operations Procedure (TOP) describes general procedures for conducting nonballistic testing of soft armor systems. Tests include Bulk Materials, Visual Inspection, Bartacks, Component and Assembly, Construction Design, Emergency Release Mechanism, Functional Integration, Hardware, Label Verification: Verbiage, Label Verification: Dimensions and Font, Open Seam, Stitch Count, Stitch and Seam Type, Raw Edges, Stitch Tension, Thread Ends, Weight, Materials Inspection Testing, Ballistic Filler Weight, Ballistic Panel Subcomponent Fit and Area, Bartack Holding Strength, Dimensions: Bartack Length, Distance between Bartacks, Distance between Horizontal Webbing, Buttonhole Cut, Length and Width, Drag Strap Extension Test Using Instron Machine, Emergency Release Anchor Webbings, Pattern Matching, Pattern Matching: Ballistic Filler, Ply Count, Thickness: Ballistic Filler, and Vertical Alignment of Bartacks.

15. SUBJECT TERMS
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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

*Test Operations Procedure 10-2-204 23 July 2012
DTIC AD No. :

GENERAL TESTS OF PERSONAL PROTECTIVE EQUIPMENT (NON-BALLISTIC) - SOFT ARMOR

Approved for public release; distribution unlimited.

1. SCOPE.

This Test Operations Procedure (TOP) provides the test methodology for nonballistic (NB) testing of soft body armor (SBA) personal protective equipment (PPE), and includes the requirements for First Article Tests (FATs) and Lot Acceptance Tests (LATs). The purpose of this testing is to evaluate the safety, reliability, conformance, and performance (NB) of commercial off-the-shelf (COTS) and developmental SBA material manufacturing and system assembly. This TOP does not include detailed testing procedures for textile testing performed at laboratories outside the US Army Aberdeen Test Center (ATC), but does specify which subtest is performed at each laboratory.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

Facilities required are defined in Appendix A. Specific subtests are performed at the locations described in Appendix B.

2.2 Instrumentation.

All instrumentation required is specified within the individual methods and procedures documents listed in Appendix I. The documents provided in that list are the commonly used reference documentation used to support NB SBA testing. Special instrumentation used during the visual or material inspection processes is shown in Appendixes C and D. Much of this instrumentation has been uniquely developed or modified by ATC laboratories specifically for NB testing of SBA.

3. REQUIRED TEST CONDITIONS.

3.1 Calibration.

All measurement instrumentation will be calibrated in accordance with US Army Test, Measurement, and Diagnostic Equipment (TMDE) schedules as defined by the calibration standards and/or equipment specification of the laboratory. Random calibration verifications will be performed, as necessary. Records of calibration and verifications will be maintained in laboratory notebooks.

3.2 Requirements Document(s).

All current purchase description requirements, appropriate specifications, and test methods will be reviewed prior to test start. The subtests chosen and required methods selected will be tailored to the individual test item(s). Testing of materials by outside laboratories will be carefully planned to ensure testing is performed by the most qualified and cost-effective laboratory.

3.3 Overview of Processes.

There are five distinct phases in the overall process for SBA testing: 1) test item receipt and processing, 2) test conduct, 3) data entry and analysis, 4) data reviewing and reporting, and 5) management approval and Versatile Information System Integrated On-Line (VISION) Digital Library System (VDLS) upload.

a. Test Item Receipt and Processing. During the test item receipt and processing phase, the test items are transported from their arrival location and taken for processing. All test items are logged into the Laboratory Information Management System (LIMS), placed in a plastic bag and labeled with a unique bar code.

b. Test Conduct. During the test conduct phase, any testing required for the individual test items is performed. During testing, photographs are taken of key findings for inclusion in the test report.

c. Data Entry and Analysis. During the data entry and analysis phase, two separate data entry personnel will record test data into an electronic data work sheet. Upon completion of data entry by both personnel, a data analyst will review the work sheets for discrepancies prior to the review by a qualified quality assurance person. Once the data entered by both data entry personnel are confirmed to be identical, the data analyst is responsible for photographing all findings.

d. Data Reviewing and Reporting. Quality assurance personnel will review the electronic data work sheets for completeness, accuracy, and discrepancies by data analysts. This individual will also review each photograph to ensure the discrepancies are recognizable and properly depicted. After the review is complete, a draft report is created and sent for review by the SBA lead or designee. After the SBA lead or designee reviews and approves the data and the associated photographs, a final test report is prepared and sent to management.

e. Management Approval and VDLS Upload. In the final phase of the process, management reviews and approves the test report, and the report is sent to the customer and uploaded into VDLS.

3.4 Chain of Custody.

a. Upon arrival, all test items will be inspected to confirm that the customer has provided ATC with all required test materials. Test items for FATs require two complete assemblies of each size and the associated bulk materials, while LATs requires a minimum of two complete assemblies in each size. After initial inspection, test items are transported to the sample log-in area and logged into the LIMS. Each type of bulk material and any individual components are logged into the Bulk Material Database in Microsoft Access. Complete assemblies are placed in plastic bags and labeled with the vendor's name, lot number, and size. All identical pieces are differentiated by placing a 1 or 2 on the label.

b. Chain of custody for all test item components is maintained throughout testing using the LIMS. When test items leave a facility, the location of the items should be updated to the receiving facility in the LIMS by the person transporting the items. The location of all components at any time should be available by checking the LIMS.

3.5 Training/Certifications.

a. All analysts and data reviewers involved in testing will be competent to perform their assigned tasks. Training will be conducted, as necessary, and a written exam given to all responsible test personnel to ensure all procedures are understood. A training form should be completed by the trainer and signed by the trainee, trainer, and management. These records should be maintained by quality assurance personnel.

b. Trainers must have the necessary credentials to perform training. This may include a degree in a related program of study, a training certificate from a recognized course, or on-the-job training.

3.6 Quality Control.

a. For visual inspections of SBA, two inspectors will independently inspect the items using the same, but separate, data collection forms. Both sets of data forms will be compared and any discrepancies between the two inspectors will be reviewed by a third inspector to make a final determination on findings.

b. For material testing, all data must be reviewed for accuracy and completeness by a trained and authorized data reviewer. All data entered by the analyst must be electronically approved by a data reviewer. For visual inspections, the third inspector is also the reviewer.

4. TEST PROCEDURES.

4.1 Bulk Material Testing.

All bulk materials are received, inventoried, and sorted at ATC for distribution to responsible laboratories. Upon receipt, all bulk materials and components are carefully inspected for damage that may have occurred during the shipping process. The materials and components are then inventoried. Each item is counted and compared against the inventory sheet provided by the vendor. Samples are cut or gathered of each bulk material or component and placed in individual bags labeled with item name, size, color, and the destination test location. The bags are grouped according to their destination test site and placed in boxes. The boxes are then mailed or delivered to an ATC laboratory or one of the outside test laboratories listed in Appendix A.

4.2 Visual Inspection Testing.

4.2.1 Bartacks.

a. Method. This test is performed to ensure that each bartack is present, properly constructed and that no operation has been omitted.

(1) Determine if any bartack run-offs are visible (Appendix E, Figure E-1).

(2) Review working patterns to determine if any bartack is missing (Appendix E, Figure E-2).

(3) Determine if any bartack is too short in length, which indicates it is not complete.

(4) Determine if any bartack is not properly constructed (Appendix E, Figure E-3).

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.2 Component and Assembly.

a. Method. This test is performed to ensure that each component is present, in good condition, properly assembled, and that no operation has been omitted.

(1) Review working patterns or sewing instructions provided and determine if any component is missing.

(2) Review the working patterns or sewing instructions provided and inspect the test item for missing or incomplete sewing operations.

(3) Review the working patterns provided and ensure components are not misaligned or off-centered (Appendix E, Figures E-4 and E-5).

(4) Inspect for the presences of holes in fabric or components (Appendix E, Figure E-6).

(5) Inspect for components that are joined together improperly (e.g., sewn at/on wrong side, using incorrect stitching or upside down, etc.) (Appendix E, Figure E-7).

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.3 Construction.

a. Method. This test is performed to ensure that garment pieces are properly joined together. Edge stitching should not be less than or greater than the measurement specified in the requirement(s) document.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) All deficiencies (labeled and photographed).

4.2.4 Design.

The purpose of this test is to visually inspect that all components of the test item are present and match their intended design.

a. Method.

(1) Ensure that the test item matches its intended design.

(2) Ensure all components are present.

(3) Ensure key design features are present.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing of any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.5 Emergency Release Mechanism (ERM): Vest.

a. Method. The purpose of this testing is to determine if a prequalified test participant (TP) is able to pull free the ERM barehanded and gloved (Appendix G). During the FAT, a force gauge will be used to measure the pound-force (lbf) required to pull the ERM free from the vest. If Soldiers are desired, ensure a Test Schedule and Review Committee (TSARC) request is submitted within one year from the start of testing or as early as possible.

(1) Locate and qualify a TP.

(2) Contact the TP and provide the TP with an estimated time and date to perform the ERM pull.

(3) Assemble the vest in its entirety.

(4) Insert hard armor plates into the respective pockets of the vest.

(5) After the TP arrives, have the TP don the vest.

(6) Have the TP take a stable/firm stance to avoid being pulled over or falling.

(7) Force gauge measurement (FAT only):

(a) Turn on and zero the force gauge device (Appendix C, Figure C-2).

(b) Attach the hooked end of the force gauge to the handle or loop of the release cable.

(c) Steadily pull the attached force gauge to the right at a 45 degree angle from the TP's chest area, until the cable becomes completely free of the vest.

(d) Record force gauge measurement.

(e) Reassemble the vest and repeat the steps in paragraphs 4.2.5.a(7)(b), through 4.2.5.a(7)(d) an additional two times.

(f) Reassemble the vest and steadily pull the attached force gauge to the left at a 45 degree angle from the TP's chest area, until the cable becomes completely free of the vest.

(g) Record force gauge measurement.

(h) Repeat steps in paragraphs 4.2.5.a(7)(b), 4.2.5.a(7)(f), and 4.2.5.a(7)(g) two additional times.

(i) Reassemble the vest and steadily pull the attached force gauge to the center at a downward 45 degree angle from the TP's chest area, until the cable becomes completely free of the vest.

(j) Record force gauge measurement.

(k) Repeat step in paragraphs 4.2.5.a(7)(b), 4.2.5.a(7)(i), and 4.2.5.a(7)(j) two additional times.

(8) Barehanded:

(a) Reassemble the vest and have the TP pull the ERM with the right bare hand at a 45 degree angle until the cable is pulled completely free of the vest (Appendix E, Figure E-8).

(b) Reassemble the vest and have the TP pull the ERM with the left bare hand at a 45 degree angle until the cable is pulled completely free of the vest.

(9) Gloved:

(a) Reassemble the vest and have the TP pull the ERM with the right hand at a 45 degree angle, while wearing the provided cold weather glove (Appendix C, Figure C-1), until the cable is completely free of the vest (Appendix E, Figure E-9).

(b) Reassemble the vest and have the TP pull the ERM with the left hand at a 45 degree angle, while wearing the provided cold weather glove, until the cable is completely free of the vest.

b. Data Required. Record the following:

(1) The pound-force (lbf) measurement on the force gauge after each pull.

(2) A met or not met classification for each barehanded and gloved pull test.

(3) Notations describing any problems with functionality.

(4) All deficiencies (photographed or videotaped).

4.2.6 Functional Integration.

a. Method. This test is performed to ensure all components function properly when assembled with different items of the same sized lot.

(1) Choose any combination of two removable components from two test items of the same-sized lot.

(2) Remove the same components from both test items.

(3) Attach or insert the removed components into/onto the opposing vest.

(4) Visually inspect each test item, ensuring that the components are capable of being properly attached or inserted and exhibit no obvious signs of distortion that would cause degradation to performance.

(5) Remove the components and place them back on the corresponding test item.

(6) If no distortion is present, each test item will have met its requirement for functional integration.

b. Data Required. A met or not met classification will be recorded for each test item.

4.2.7 Hardware.

a. Method. This test is performed to ensure all hardware is physically intact and visually acceptable.

(1) Ensure there are no nicks, scrapes, or deformities present. (Appendix E, Figure E-10).

(2) Ensure the hardware has been coated the color specified in the requirements document.

(3) Ensure no hardware is broken or damaged.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.8 Label Verification: Verbiage.

a. Method.

(1) Carefully compare the verbiage on the label to that in the requirements document(s).

(2) Determine if any verbiage is missing.

(3) Determine if any verbiage is incorrect.

(4) Determine if there is any additional verbiage.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.9 Label Verification: Dimensions and Font.

a. Method. Verify that:

(1) The dimensions of the label match those given in the requirements document(s).

(2) The required amount of quiet space is present.

(3) The font size is correct.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.10 Open Seams.

a. Method. This test is performed to determine if any seam has been ruptured or been left open.

(1) Look for consecutively missed stitches that have created an opening.

(2) Look for seams that have come undone, thus, creating an opening.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.11 Stitch Count.

a. Method. This test is performed to ensure that each stitch within a 2.5-centimeter (cm) (1-inch (in.)) area is within the acceptable number of stitches per inch (SPI).

(1) Randomly place the pick glass (Appendix C, Figure C-3) down onto the fabric with the ruler side along the stitch line. Be sure that each stitch between the pick glass' 1-in. ruler is completely viewable.

(2) Count the number of individual stitches within the given space (Appendix E, Figure E-11).

(3) Randomly repeat this process five times on each component.

b. Data Required. The acceptable number of SPI will be spelled out in the requirements document(s). The number of stitches counted per inch should be recorded for any that do not meet the specified SPI.

4.2.12 Stitch and Seam Type.

a. Method. This test is used to determine if the correct stitch and seam type have been used to join together component pieces.

(1) Inspect all stitch lines to ensure stitch types match the specified requirement.

(2) Inspect all seams to ensure seam types match the specified requirement.

b. Data Required. Record the following:

(1) A met or not met classification for each inspected item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.13 Raw Edges.

a. Method. The purpose of this test is to determine if all fabric edges are properly encased within the seam.

(1) Inspect all binding edges for exposed areas.

(2) Inspect to ensure no fabric has fallen out of seam (fall out).

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) All deficiencies (labeled and photographed).

4.2.14 Stitch Tension.

a. Method. This test is used to ensure that no stitches are too loose or too tightly sewn, and that stitch tension is consistent throughout the sewing operation.

(1) Verify that seams are not puckered or pleated, which indicate tight stitch tension.

(2) Verify that seams are not open or threading is not loose, which indicates loose stitch tension.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.2.15 Thread Ends.

a. Method. The purpose of this test is to carefully inspect thread ends for untrimmed threading that exceeds the length specified in the requirements document(s).

(1) Excess threading should be properly trimmed.

(2) Untrimmed threads should be properly back-tacked.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) All deficiencies (labeled and photographed).

4.2.16 Weight: Individual Component and System.

a. Method. This test is performed to determine if the individual components of a test item, as well as the entire system weights, are less than or equal to the maximum weights given in the requirements document(s).

(1) Set the scale (Appendix D, Figure D-5) to pounds (lb).

(2) Zero the scale.

(3) Place each component on the scale and record its weight.

(4) Place the entire system on the scale and record the weight.

b. Data Required. Record the weight to three decimal places.

4.3 Materials Inspection Testing.

4.3.1 Ballistic Filler Weight.

a. Method. This test is performed to determine if the individual components of a test item, as well as the entire system weights are less than or equal to the maximum weights given in the requirements document(s).

(1) Remove complete ballistic filler from cover.

(2) Place ballistic filler on scale.

b. Data Required. Record the weight to three decimal places.

4.3.2 Ballistic Panel Subcomponent Fit.

a. Method. This test is used to verify that each ballistic panel easily and properly fits within the respective carrier.

(1) Insert the ballistic insert into the back carrier.

(2) Check for bunching.

(3) Check to determine whether the hook and loop fabric on the insert matches the hook and loop fabric placement inside the carrier (if applicable).

(4) Remove the insert from the carrier.

b. Data Required. If there is no difficulty inserting or removing the ballistic subcomponents, the criterion is met and the results should be recorded.
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4.3.3 Ballistic Panel Area.

a. Method. This test is performed to ensure the area fits the criteria of the minimum ballistic area.

(1) Each ballistic panel is traced and measured with a planimeter (Appendix D, Figure D-3) for accuracy.

(2) Each ballistic panel is held up against the original ballistic pattern.

b. Data Required. If the traced panels match, the pattern is considered a met and the results should be recorded.

4.3.4 Bartack Holding Strength.

a. Method. The purpose of testing the bartack holding strength is to determine if the bartack can withstand the stress of the specified weight.

(1) The component is clamped to a firm fixture that will keep the component static and allow the weight to hang freely.

(2) Once the component is hanging, a specified weight is attached to the modular lightweight load-carrying equipment (MOLLE) attachment point.

(3) The weight is suspended from the bartack for 60 seconds.

b. Data Required. If the component shows no signs of deformation or breakage after a minimum of 60 seconds, the criterion is met and the results should be recorded.

4.3.5 Dimensions: Bartack Length.

a. Method.

(1) Measure a representative sample of bartack lengths.

(2) A straight measurement along the length of the bartack is recorded.

b. Data Required. Record the following:

(1) If bartack length measurement is within the specified requirement, the criterion is met and the results should be recorded.

(2) Any measurement that does not meet the requirement noted in inches.

4.3.6 Dimensions: Distance Between Bartacks.

a. Method. This test is performed to measure the area between each bartack.

(1) Measure a representative sample of distances between bartacks, from the center of a bartack to the center of the adjacent bartack (Appendix F, Figure F-1).

(2) The distance between the bartacks should meet the specified requirement.

b. Data Required. Record the following:

(1) If one measurement is not within the specified requirement, the criterion is not met and the results should be recorded.

(2) Notations describing any irregularities.

(3) All deficiencies (photographed).

4.3.7 Dimensions: Distance Between Horizontal Webbing.

a. Method. This test is performed to measure the distance between all horizontal webbing. Measure the distance between all horizontal webbing from the bottom of one webbing to the top of the adjacent webbing along the centerline of the webbing (Appendix F, Figure F-2).

b. Data Required. Record the following:

(1) If one measurement is not within the specified requirement, the criterion is not met and the results should be recorded.

(2) Notations describing any irregularities.

(3) All deficiencies (photographed).

4.3.8 Dimensions: Buttonhole Cut.

a. Method. The purpose of this test is to ensure that the buttonholes are cut in the proper position according to the pattern. To measure, insert the ATC-devised buttonhole measurer (small end first) (Appendix D, Figure D-10) to a snug fit (Appendix F, Figure F-5).

b. Data Required. Record the following:

(1) The measurements as fractions.

(2) Notations describing any irregularities.

(3) All deficiencies (photographed).

4.3.9 Dimensions: Length and Width.

a. Method. Measure the length (at the center of the test item) and width using a yard-long scale (fixed to laboratory table; Appendix D, Figure D-7 and Appendix F, Figure F-8). Compare the measurement to the specified requirement.

b. Data Required. Record the following:

(1) Whether the measurements meet or do not meet the criteria.

(2) If the measurement does not meet, provide specific data (such as a measurement of the distance it is off).

4.3.10 Drag Strap Extension Test Using Instron Machine: (If Applicable).

a. Method. This test is used to measure the strength of the drag strap.

(1) Mark the location of the ends of the drag strap on the outside of the vest using ball-point or indelible ink (Appendix F, Figure F-9).

(2) Place the vest on the Instron machine fixture, outside down, with the neckline away from you. Fold in the outer flaps.

(3) Line up the top of the 4-in. webbings with the bolts on the test fixture. Place one bar over the bolts (Appendix F, Figure F-10). Bring the top of the vest over the first bar, and place the second bar over the bolts (Appendix F, Figure F-11).

(4) Make sure that the drag strap end (marked) is within 0.64 cm (0.25 in.) of the bar. If necessary, pull the vest to adjust its position. Do not allow the drag strap end to be underneath the bar. Tighten the nuts over the bolts on the test fixture.

(5) Insert the cross-bar of the Instron machine (Appendix D, Figure D-6) through the drag strap loop, and insert the cross-bar into the Instron machine fixture. Adjust the cross-bar fixture and raise it to approximately 4.45 Newton (N) (1 lbf) of pull on the strap (until strap is snug) (Appendix F, Figure F-12).

(6) Input the sample number being tested and date of test.

(7) Select Next.

(8) Balance the load and the extension. Run the extension test.

(9) Loosen the test fixture nuts, and remove bars and vest from the fixture.

b. Data Required. Record the following:

(1) The extension (in.) at the break of the first stitch and at the maximum load to two decimal places.

(2) The load (lbf) at the first stitch break and the maximum load to one decimal place.

(3) Notations describing any irregularities or problems.

4.3.11 Emergency Release Anchor Webbings.

a. Method.

(1) To measure, first insert a 0.64-cm (0.25-in.)-thick plate (10.2- by 10.2-cm (4- by 4-in.) or similar size) under the anchor webbing to create a flat surface. For the top loop, move the plate under the carrier. Then insert the loop into the ATC-created slotted bar and push the slotted bar down so it is flat against the plate underneath the webbings. Insert the stepped gauge into the loop to a snug fit.

(2) If the loop fits between specified requirement (Appendix D, Figure D-8 and Appendix F, Figures F-6 and F-7), the criterion is met.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.3.12 Pattern Matching.

The purpose of this test is to compare the cut component piece against the pattern to ensure that the component is the proper size, prior to the beginning of the sewing process.

a. Method. Lay the cut component piece flat on top of the correct size pattern. Center the cut piece on the pattern, and examine the outline to determine whether it matches the pattern.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.3.13 Pattern Matching: Ballistic Filler.

a. Method. The purpose of this test is to compare the cut ballistic filler against the pattern to ensure that the filler is the proper size.

(1) Completely remove the ballistic filler using a razor knife (Appendix D, Figure D-9) or equivalent.

(2) Carefully place the ballistic filler on the pattern.

b. Data Required. Record the following:

(1) A met or not met classification for each tested item.

(2) Notations describing any deficiencies.

(3) All deficiencies (labeled and photographed).

4.3.14 Ply Count.

a. Method. This test is used to count the number of ballistic layers in a ballistic component. Starting from the label side of the filler, count the number of layers of ballistic material in the filler by type (e.g., 500, 850, then 500 Denier) and the total number of layers (Appendix F, Figure F-4).

b. Data Required. Record the following:

(1) Any irregularities, such as folded layers (with measurement of folded portion) or misalignment of layers.

(2) The numerical results of the count.

4.3.15 Thickness: Ballistic Filler.

a. Method. This test is performed to measure the thickness of the ballistic filler.

(1) Cut the ballistic covering with a razor knife (Appendix D, Figure D-9) or equivalent to expose an area (on both sides) of the ballistic filler.

(2) Using a fabric thickness gauge (Appendix D, Figure D-4), measure the thickness of the filler at the pressure specified in the requirements document(s) (Appendix F, Figure F-3).

b. Data Required. Record the following:

(1) Results to two decimal places.

(2) Notations describing any irregularities.

4.3.16 Vertical Alignment of Bartacks.

a. Method. This test is performed to ensure the bartacks are aligned vertically. Align a standard 30.5-cm (12-in.) scale (Appendix D, Figure D-1) with the top and bottom of the bartack, in the center of the webbing (Appendix F, Figure F-1). Determine whether all bartacks are in alignment.

b. Data Required. Record the following:

(1) If any bartack is not properly aligned, the criterion is not met.

(2) Notations describing any irregularities.

(3) All deficiencies (labeled and photographed).

5. DATA REQUIRED.

Data collection requirements are specified under each subtest.

6. PRESENTATION OF DATA.

a. Once the data from each inspection is entered into the LIMS, the visual and materials test data will be presented in the form of a report. The report will list each subtest, its requirement, and the actual test results in tabular form. Any test results that do not meet the specified requirements will be displayed in red. A sample data table is provided as Figure 1.

SAMPLE

-0344

Lot Acceptance Test — Report Date: 07-May-2012

Serial Number: — Batch ID:

Component: Release Cable — Size: Medium to Large-Long — Ballistic Package:n/a

Test	Sub Test	Result	Units	Specification
3.5.3.9 - Release Cable	Handle Pull Strength	236	lb force	100 lbf min.
3.5.3.9 - Release Cable	Release Cable Long	33 3/16	in.	33 ± 1/4
3.5.3.9 - Release Cable	Release Cable Short	26	in.	26 ± 1/4
4.5.1 - End Item Defects	Breaks, Skips, or Run-Offs	Met		App-C, Table II
4.5.1 - End Item Defects	Cabling	Met		App-C, Table II
4.5.1 - End Item Defects	Component & Assembly	Met		App-C, Table II
4.5.1 - End Item Defects	Fastener Tape	Met		App-C, Table II
4.5.1 - End Item Defects	Label	Met		App-C, Table II
4.5.1 - End Item Defects	Raw Edges	Met		App-C, Table II
4.5.1 - End Item Defects	Seam and Stitch Type	Met		App-C, Table II
4.5.1 - End Item Defects	Seams and Stitching	Met		App-C, Table II
4.5.1 - End Item Defects	Stitch Tension	Met		App-C, Table II
4.5.1 - End Item Defects	Stitching Ends	Met		App-C, Table II
4.5.1 - End Item Defects	Webbing or Tape	Met		App-C, Table II
4.5.1 - End Item Defects (Material)	Component & Assembly	Met		App-C, Table II

Notes:
Cable casing is white in color

Figure 1. Sample data table.

b. Test data received from outside laboratories will be presented in the form of individual test reports and attached to the ATC Final Report as appendixes. These test reports may be presented in graphical, tabular, pictorial and/or narrative form as necessary.

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APPENDIX A. TEST FACILITY LOCATIONS.

Defense Logistics Agency (DLA) Product Testing Center - Analytical
Naval Support Activity
700 Robbins Avenue, Building 5-D
Philadelphia, PA 19111-5098

US Army Natick Soldier Research, Development, and Engineering (RD&E) Center (NSRDEC)
Textile Performance Facility Warfighter Protection and
Aerial Delivery Directorate Natick Soldier Center
15 Kansas Street
Building 5
Natick, MA 01760-5019

U.S. Army Aberdeen Test Center (ATC)
ATTN: TEDT-AT-WF (Textile Standards and Test Laboratory, Building 362)
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

ATC
ATTN: TEDT-AT-WF (Chemical Sampling and Analysis Laboratory, Building 362)
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059
Chemical Sampling and Analysis Laboratory

ATC
ATTN: TEDT-AT-WF (Visual Inspection Laboratory, Building 600)
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

ATC
ATTN: TEDT-AT-WF (Materials and Measurements Test Laboratory, Building 400)
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

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APPENDIX B. SUBTESTS PERFORMANCE LOCATIONS.

TABLE B-1. PERFORMANCE LOCATIONS

Subtest	Location	FAT	LAT[a]
Breaking Strength	AML/NSRDEC	X	-
Elongation Percentage	AML/NSRDEC/DLA	X	-
Dimensional Stability	NSRDEC	X	-
Abrasion Resistance	ACL/NSRDEC	X	-
Spray Rating	ACL	X	-
Hydrostatic Resistance	NSRDEC	X	-
Dynamic Absorption	NSRDEC	X	-
Resistance to Organic Liquid	ACL	X	-
Weight	AML/NSRDEC	X	-
Colorfastness	NSRDEC	X	-
Flame Resistance	ACL	X	-
Fungus Resistance	ACL	X	-
Pattern Execution	NSRDEC	X	-
Matching to Standards	NSRDEC	X	-
Camouflage	NSRDEC	X	-
Infrared (IR) Reflectance	NSRDEC	X	-
Material Identification	AML/ACL/DLA	X	-
Fiber	DLA	X	-
Yarn	DLA	X	-
Yarn Count	DLA	X	-
Weave	NSRDEC	X	-
Denier	DLA	X	-
pH	NSRDEC	X	-
Width	AML/ NSRDEC	X	-
Thickness	AML/ NSRDEC/ DLA	X	-
Length	AML/DLA	X	-
Curvature	NSRDEC	X	-
Brightness	DLA	X	-
Tenacity	DLA	X	-
Location	AML	X	-
Measurements/Dimensions	AML/ NSRDEC/DLA	X	-
Selvage Width	NSRDEC	X	-
Construction/Composition	AML	X	-
Resistance to Low Temperature	ACL	X	-

APPENDIX B. SUBTESTS PERFORMANCE LOCATIONS.

TABLE B-1 (CONT'D)

Subtest	Location	FAT	LAT[a]
Resistance to High Humidity	ACL	X	-
Blocking	ACL	X	-
Density	AML/DLA	X	-
Flexibility	NSRDEC	X	-
Shear Strength	NSRDEC	X	-
Peel Strength	NSRDEC	X	-
Tear Strength	NSRDEC	X	-
Fray Resistance	NSRDEC	X	-
Compression Strength	AML	X	-
Ply	NSRDEC/ DLA	X	-
Twist	DLA	X	-
Nominal Tex Number	DLA	X	-
Melting Point	DLA	X	-
Weld	AML	X	-
Coating	AML	X	-
Stretch	DLA/NSRDEC	X	-
Rubber Stretch	DLA	X	-
End Item Physical Characteristics	AVL/AML	X	-
Functional Integration	AVL	X	-
Small Arms Protective Insert (SAPI) Pocket	AVL/AML	X	-
Emergency Release Mechanism	AVL/AML	X	-

[a]No laboratories are used for LATs. All testing is conducted by the ATC Soft Armor Team.

ACL = ATC Chemical Sampling and Analysis Laboratory.
AML = ATC Materials and Measurements Test Laboratory.
AVL = ATC Visual Inspection Laboratory.
DLA = Defense Logistics Agency.
NSRDEC = U.S. Army Natick Soldier Research, Development and Engineering (RD&E) Center.

APPENDIX C. VISUAL INSTRUMENTATION PHOTOGRAPHS.

Figure C-1. Cold weather gloves.

Figure C-2. Force gauge.

APPENDIX C. VISUAL INSTRUMENTATION PHOTOGRAPHS.

Figure C-3. Pick glass.

APPENDIX D. MATERIAL INSTRUMENTATION PHOTOGRAPHS.

Figure D-1. Metal steel ruler.

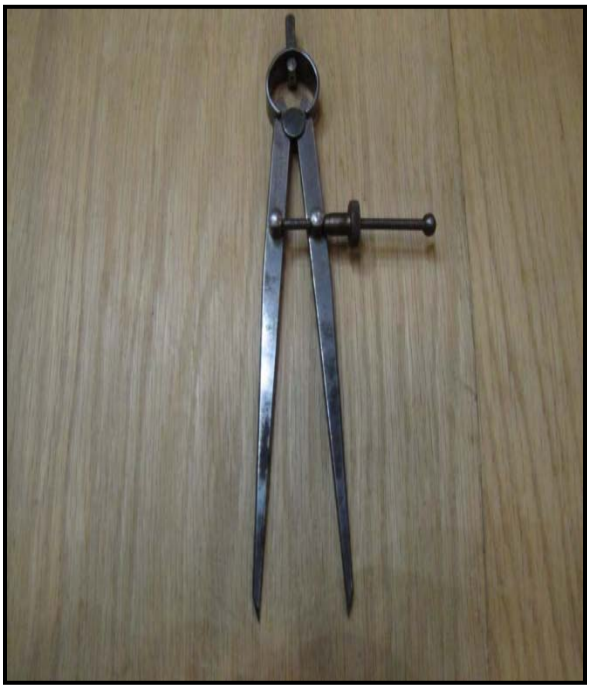

Figure D-2. Compass (bartack).

APPENDIX D. MATERIAL INSTRUMENTATION PHOTOGRAPHS.

Figure D-3. Planimeter.

Figure D-4. Thickness gauge.

APPENDIX D. MATERIAL INSTRUMENTATION PHOTOGRAPHS.

Figure D-5. Scale.

Figure D-6. Instron.

APPENDIX D. MATERIAL INSTRUMENTATION PHOTOGRAPHS.

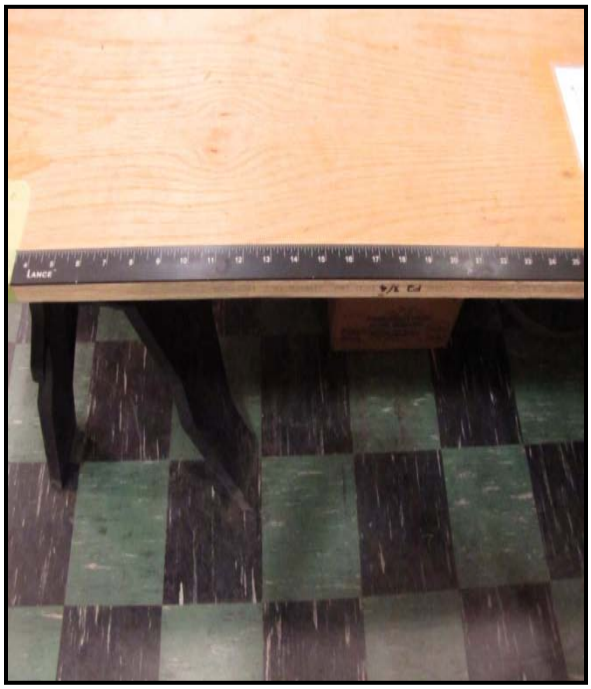

Figure D-7. Steel ruler (measure release cable).

Figure D-8. ATC loop height measuring device.

APPENDIX D. MATERIAL INSTRUMENTATION PHOTOGRAPHS.

Figure D-9. Razor knife.

Figure D-10. ATC buttonhole measuring device.

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APPENDIX E. VISUAL TEST PHOTOGRAPHS.

Figure E-1. Bartack run-off.

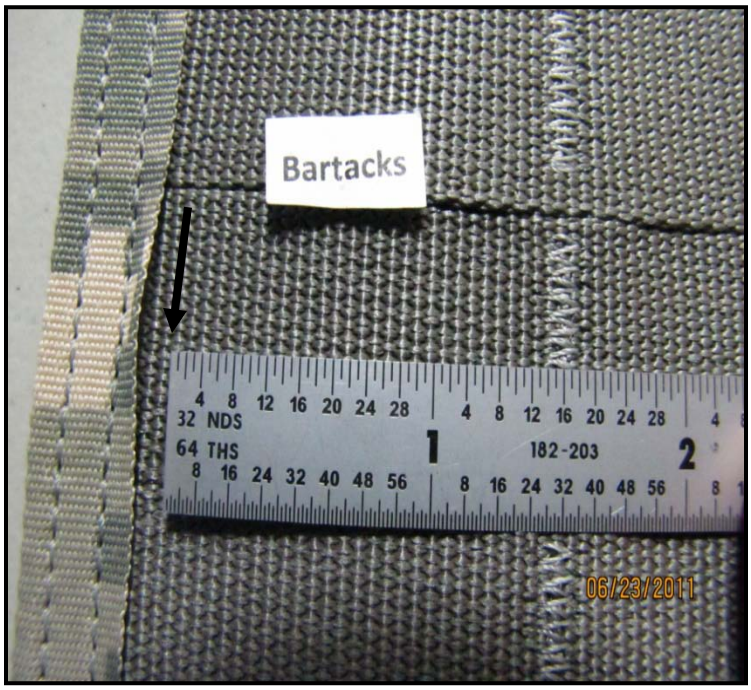

Figure E-2. Missing bartack (arrow indicates required bartack placement).

APPENDIX E. VISUAL TEST PHOTOGRAPHS.

Figure E-3. Bartack not constructed properly.

Figure E-4. Components misaligned.

APPENDIX E. VISUAL TEST PHOTOGRAPHS.

Figure E-5. Component not centered.

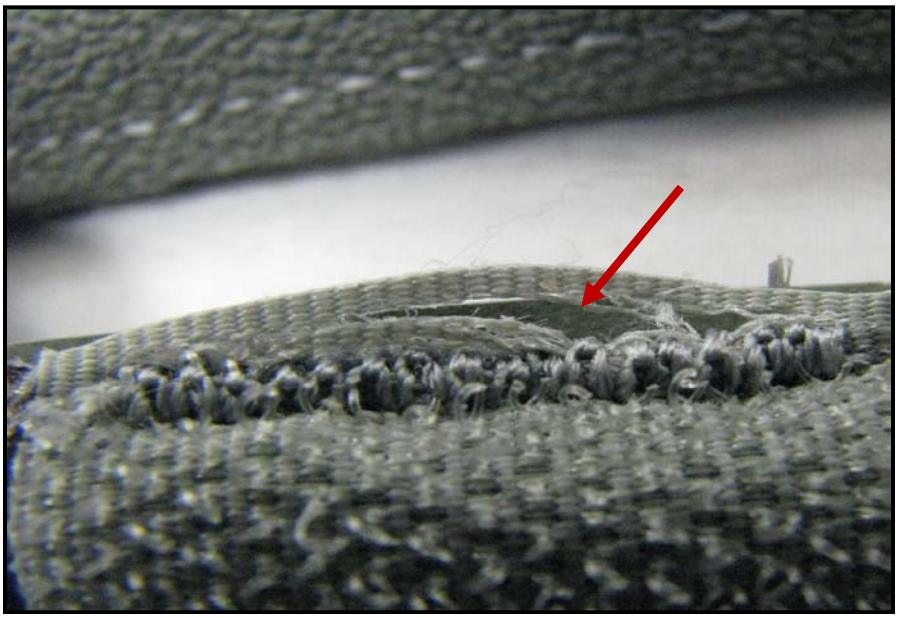

Figure E-6. Hole.

APPENDIX E. VISUAL TEST PHOTOGRAPHS.

Figure E-7. Components joined together incorrectly.

APPENDIX E. VISUAL TEST PHOTOGRAPHS.

Figure E-8. Barehanded ERM test.

APPENDIX E. VISUAL TEST PHOTOGRAPHS.

Figure E-9. Gloved ERM test.

APPENDIX E. VISUAL TEST PHOTOGRAPHS.

Figure E-10. Scratches on hardware.

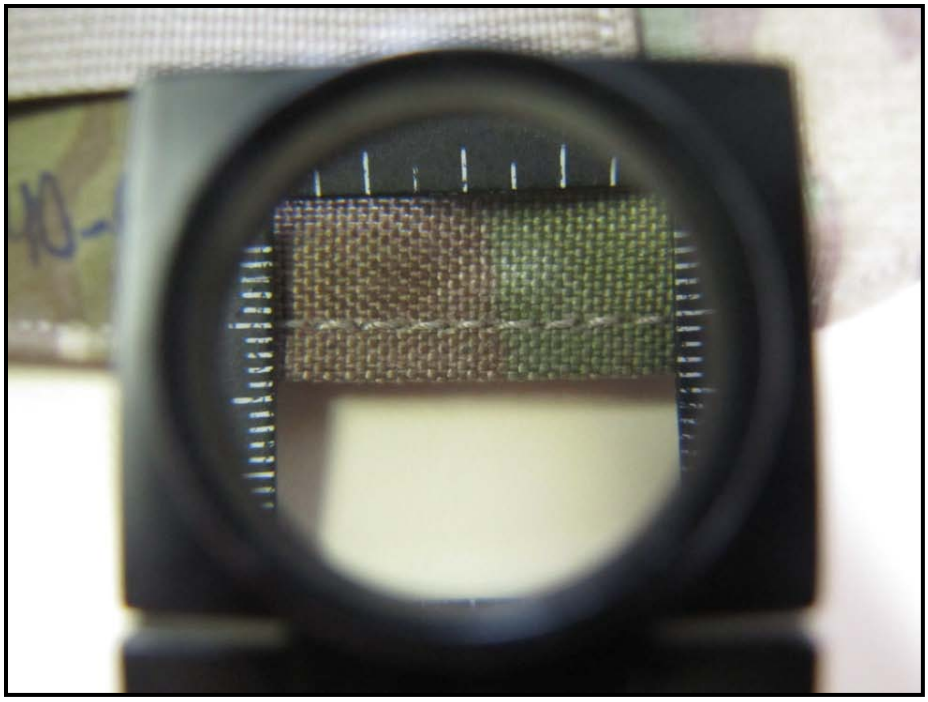

Figure E-11. Stitch count.

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APPENDIX F. MATERIAL TEST PHOTOGRAPHS

Figure F-1. Distance between bartacks.

Figure F-2. Distance between horizontal webbing.

APPENDIX F. MATERIAL TEST PHOTOGRAPHS

Figure F-3. Ballistic filler thickness.

Figure F-4. Ply count.

APPENDIX F. MATERIAL TEST PHOTOGRAPHS

Figure F-5. Buttonhole cut.

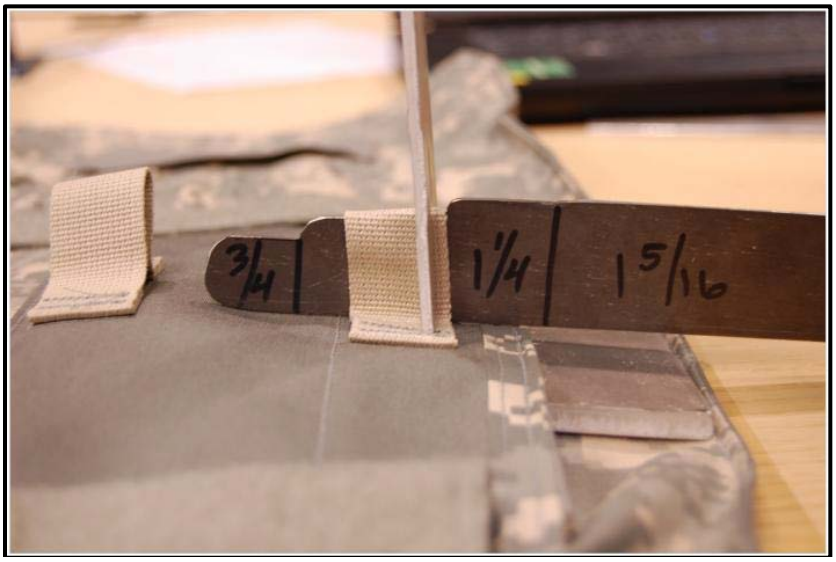

Figure F-6. Measuring emergency release anchor webbing (example of met).

APPENDIX F. MATERIAL TEST PHOTOGRAPHS

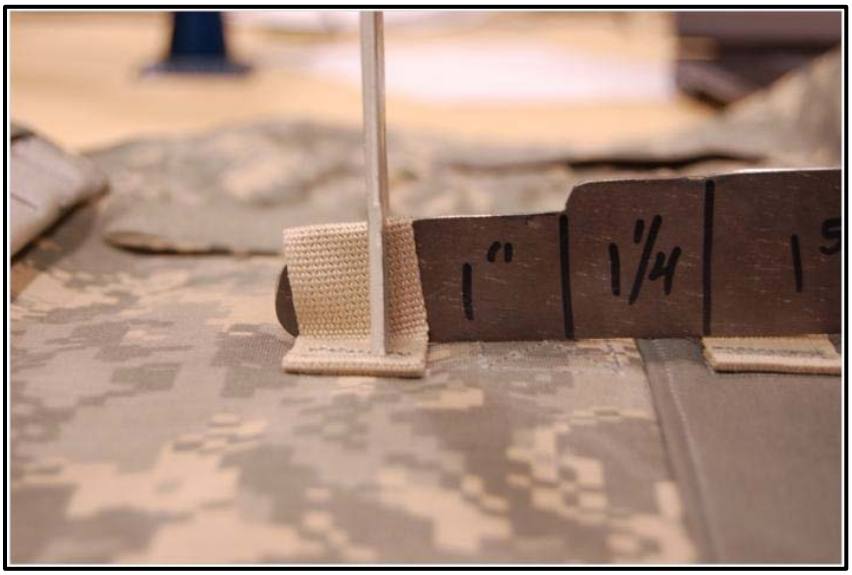

Figure F-7. Measuring emergency release anchor webbing (example of a not met).

Figure F-8. Release cable length.

APPENDIX F. MATERIAL TEST PHOTOGRAPHS

Figure F-9. Ends of the drag strap marked on the outside of the carrier.

Figure F-10. Carrier set up on first bar of test fixture.

APPENDIX F. MATERIAL TEST PHOTOGRAPHS

Figure F-11. Carrier set up on second bar of test fixture.

Figure F-12. Drag strap ready for extension test.

APPENDIX F. MATERIAL TEST PHOTOGRAPHS

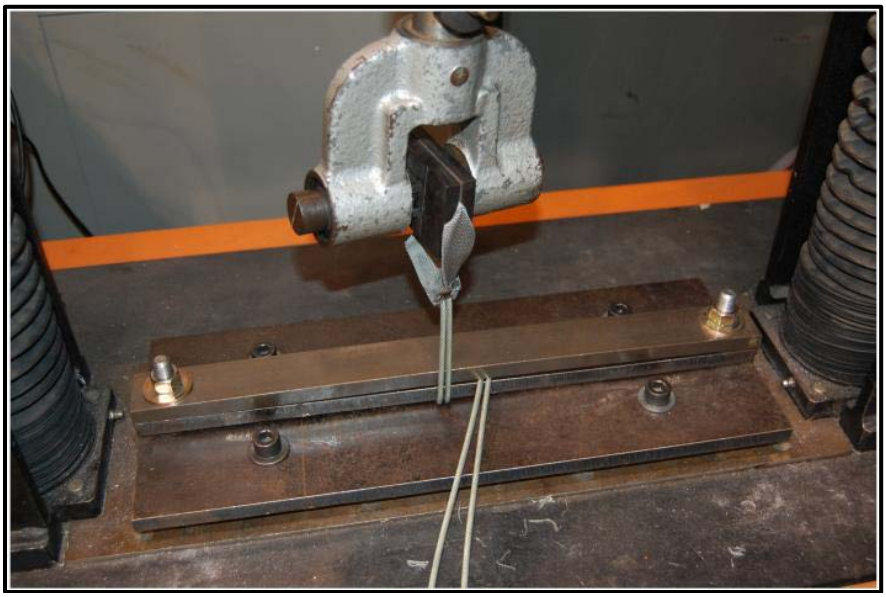

Figure F-13. Extension test setup.

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APPENDIX G. EMERGENCY RELEASE MECHANISM (ERM) TEST PARTICIPANT (TP) QUALIFICATION CHART

Size	Chest Circumference, in.
X-Small	29 to 33
Small	33 to 37
Medium-Regular and Medium-Long	37 to 41
Large-Regular and Large-Long	41 to 45
X-Large-Regular and X-Large-Long	45 to 49
2 X-Large	49 to 53
3 X-Large	53 to 57
4 X-Large	57 to 61

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APPENDIX H. ABBREVIATIONS.

AATCC	American Association of Textile Chemists and Colorists
ACL	ATC Chemical Sampling and Analysis Laboratory
AD No.	accession number
AML	ATC Materials and Measurements Test Laboratory
ASTM	American Society for Testing and Materials
ATC	US Army Aberdeen Test Center
AVL	ATC Visual Inspection Laboratory
cm	centimeter
COTS	commercial off-the-shelf
DLA	Defense Logistics Agency
DTIC	Defense Technical Information Center
ERM	Emergency Release Mechanism
FAT	First Article Test
in.	inch
IR	infrared
LAT	Lot Acceptance Test
lbf	pound-force
LIMS	Laboratory Information Management System
MIL-STD	Military Standard
MOLLE	modular lightweight load-carrying equipment
N	Newton
NB	non-ballistic
NSRDEC	US Army Natick RD&E Center
PD	Purchase Description
PPE	personal protective equipment
RD&E	research, development, and engineering
SAPI	small arms protective insert
SBA	soft body armor
SPI	stitches per inch

APPENDIX H. ABBREVIATIONS.

TM	Test Method
TMDE	test, measurements and diagnostic equipment
TOP	Test Operations Procedure
TP	test participant
TSARC	Test Schedule and Review Committee
VDLS	VISION Digital Library System
VISION	Versatile Information System Integrated On-Line

APPENDIX I. REFERENCES.

For information only (related publications).

a. Purchase Description (PD), Body Armor, Multiple Threat/Interceptor Improved Outer Tactical Vest.

b. A-A-55301, Commercial Item Description: Webbing, Textile, Textured or Multifilament Nylon, 15 November 1996.

c. MIL-W-17337F, Military Specification: Webbing, Textile, Woven Nylon, 22 January 1990.

d. MIL-PRF-5038J, Performance Specification: Tape, Textile and Webbing, Textile, Reinforcing Nylon, 5 November 1996.

e. Army GL/PD 10-07, Cloth, Duck, Textured Nylon, 26 October 2009.

f. A-A-59826, Commercial Item Description: Thread, Nylon, 3 March 2009.

g. A-A-55126B, Commercial Item Description: Fastener Tapes, Hook and Loop, Synthetic, 7 September 2006.

h. MIL-DTL-508K, Detail Specification: Cloth, Oxford, Nylon, 3 Ounce, 7 October 2005.

i. American Association of Textile Chemists and Colorists (AATCC) Test Method (TM) 81, pH of the Water-Extract from Wet Processed Textiles, 2006.

j. AATCC TM 169-2003, Weather Resistance of Textiles: Xenon Lamp Exposure, 2003.

k. AATCC TM 61-2007, Colorfastness to Laundering: Accelerated, 2007.

l. AATCC TM 15, Colorfastness to Perspiration, 2009.

m. AATCC TM 16, Option 1 or 3, Colorfastness to Light, 2004.

n. AATCC TM 8, Colorfastness to Crocking, 2007.

o. AATCC TM 96, Dimensional Changes in Commercial Laundering of Woven and Knitted Fabrics Except Wool, 2009.

p. AATCC TM 70, Water Repellency: Tumble Jar Dynamic Absorption Test, 2010.

q. American Society for Testing and Materials (ASTM) D 5170, Standard Test Method for Peel Strength (“T” Method) of Hook and Loop Touch Fasteners, 2010.

APPENDIX I. REFERENCES.

r. ASTM D 5169, Standard Test Method for Shear Strength (Dynamic Method) of Hook and Loop Touch Fasteners, 2010.

s. AATCC TM 127, Water Resistance; Hydrostatic Pressure Test, 2008.

t. ASTM D 17777, Standard Method for Testing Thickness of Textile Materials, 2011.

u. ASTM D 3776, Standard Test Methods for Mass per Unit Area (Weight) of Fabric, 2009.

v. ASTM D 5034, Standard Test Methods for Breaking Strength and Elongation of Textile Fabrics (Grab Test), 2009.

w. ASTM D 751, Standard Test Methods for Coated Fabrics, 2011.

x. ASTM D2261-A, Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine), 2011.

y. AATCC TM 20, Fiber Analysis; Qualitative, 2011.

z. ASTM D276, Standard Test Methods for Identification of Fibers in Textiles, 2012.

aa. AATCC TM 135, Dimensional Changes of Fabrics after Home Laundering, 2010.

bb. ASTM D 3886 Standard Test Method for Abrasion Resistance of Textile Fabrics (Inflated Diaphragm Apparatus), 2011.

cc. ASTM D3884, Standard Guide for Abrasion Resistance of Textile Fabrics, (Rotary Platform, Double Head Method), 2009.

dd. ASTM D1388-Standard Test Method for Stiffness of Fabrics, 2008.

ee. A-A-55217, Commercial Item Description: Thread, Aramid, Spun Staple, 19 October 1999.

ff. ASTM D1424-09, Standard Test Method for Tearing Strength of Fabrics by Falling-Pendulum Type (Elmendorf) Apparatus, 2009.

gg. Military Standard (MIL-STD)-130N, Department of Defense Standard Practice Identification Marking of U.S. Military Property, 17 December 2007.

hh. ASTM D 6193, Standard Practice for Stitches and Seams, 2011.

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ii. MIL-DTL-32075, Detail Specification: Label: For Clothing, Equipage, and Tentage (General Use), 17 October 2000.

jj. MIL-DTL-10884H, Detail Specification: Fasteners, Snap, 20 July 2005.

kk. ASTM D3575, Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers, 2008.

ll. ASTM D 6413-08, Standard Test Method for Flame Resistance of Textiles (Vertical Test), 2008.

mm. AATCC TM 118, Oil Repellency: Hydrocarbon Resistance Test, 2007.

nn. AATCC TM 22, Water Repellency; Spray Test, 2010.

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APPENDIX J. APPROVAL AUTHORITY.

CSTE-TM 6 August 2012

MEMORANDUM FOR

Commanders, All Test Centers
Technical Directors, All Test Centers
Directors, US Army Evaluation Center
US Army Operational Test Command

SUBJECT: Test Operations Procedure (TOP) 10-2-204, General Tests of Personal Protective Equipment (Non-Ballistic) - Soft Armor, Approved for Publication

1. TOP 10-2-204, General Tests of Personal Protective Equipment (Non-Ballistic) - Soft Armor, has been reviewed by the US Army Test and Evaluation Command (ATEC) Test Centers, the US Army Operational Test Command, and the US Army Evaluation Center. All comments received during the formal coordination period have been adjudicated by the preparing agency. The scope of the document is as follows:

This TOP describes general procedures for conducting non-ballistic testing of soft armor systems and includes the requirements for First Article Tests and Lot Acceptance Tests. The purpose of this testing is to evaluate the safety, reliability, conformance, and performance (non-ballistic) of commercial off-the-shelf and developmental soft body armor material manufacturing and system assembly.

2. This document is approved for publication and has been posted to the Reference Library of the ATEC Vision Digital Library System (VDLS). The VDLS website can be accessed at https://vdls.atc.army.mil/.

3. Comments, suggestions, or questions on this document should be addressed to US Army Test and Evaluation Command (CSTE-TM), 2202 Aberdeen Boulevard-Third Floor, Aberdeen Proving Ground, MD 21005-5001; or e-mailed to usarmy.apg.atec.mbx.atec-standards@mail.mil.

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Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to the following address: Range Infrastructure Division (CSTE-TM), US Army Test and Evaluation Command, 2202 Aberdeen Boulevard, Aberdeen Proving Ground, Maryland 21005-5001. Technical information may be obtained from the preparing activity: US Army Aberdeen Test Center (TEDT-AT-WFS), 400 Colleran Road, Aberdeen Proving Ground, MD 21005-5055. Additional copies can be requested through the following website: http://itops.dtc.army.mil/RequestForDocuments.aspx, or through the Defense Technical Information Center, 8725 John J. Kingman Rd., STE 0944, Fort Belvoir, VA 22060-6218. This document is identified by the accession number (AD No.) printed on the first page.